



# Indoor Environment

## Assessment of Means Used to Obtain a Good Indoor Environment

### INTRODUCTION

A key part of improving the indoor climate in an existing building is the ability to recognize and evaluate different active and passive means designed to improve the indoor environment, and thus to understand the intentions of the original building design. These implemented means, passive and active, vary from building to building and are often determined by the intended use of the building and its age.

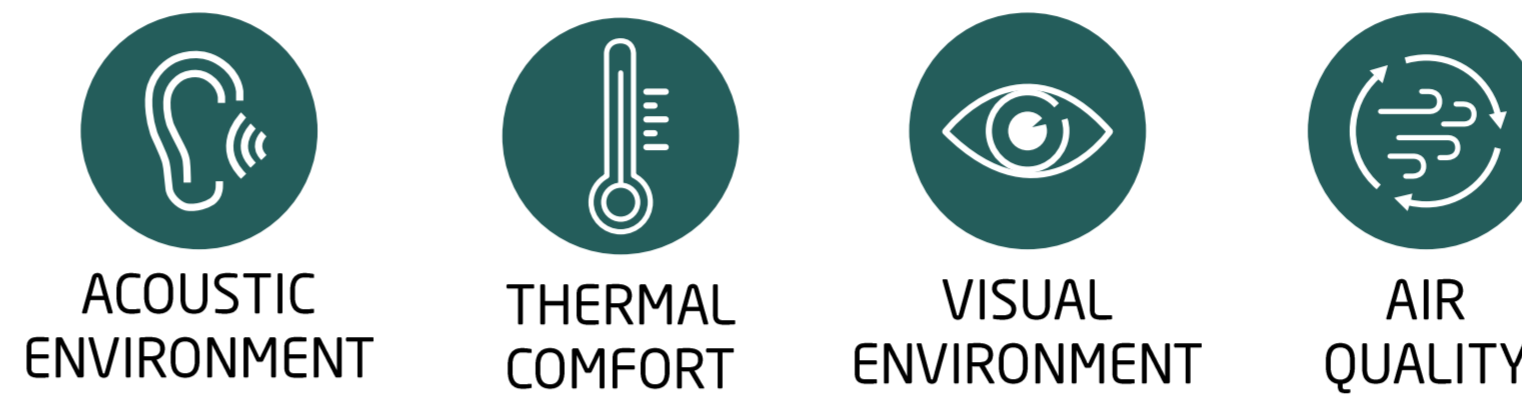
In this study two buildings, B402 and B127, was examined at The Technical University of Denmark (DTU), with the intention of assessing the means used to obtain a good indoor environment for its occupants.

On the right, the upper picture shows the exterior design of building 127 and the lower picture that of building 402.

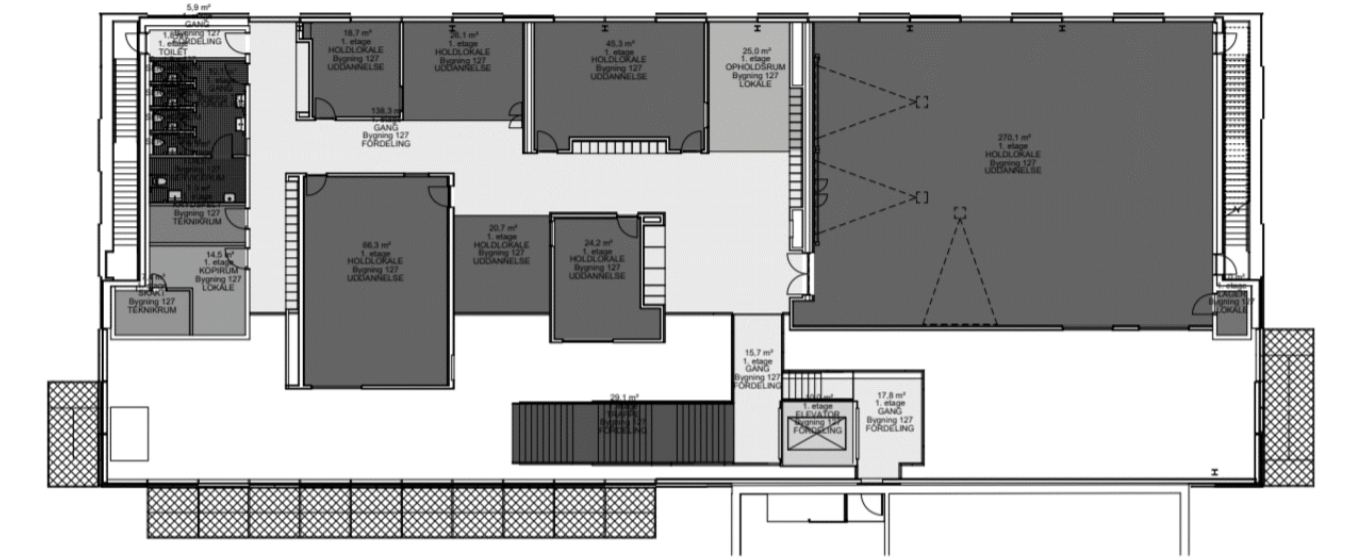


### METHODS

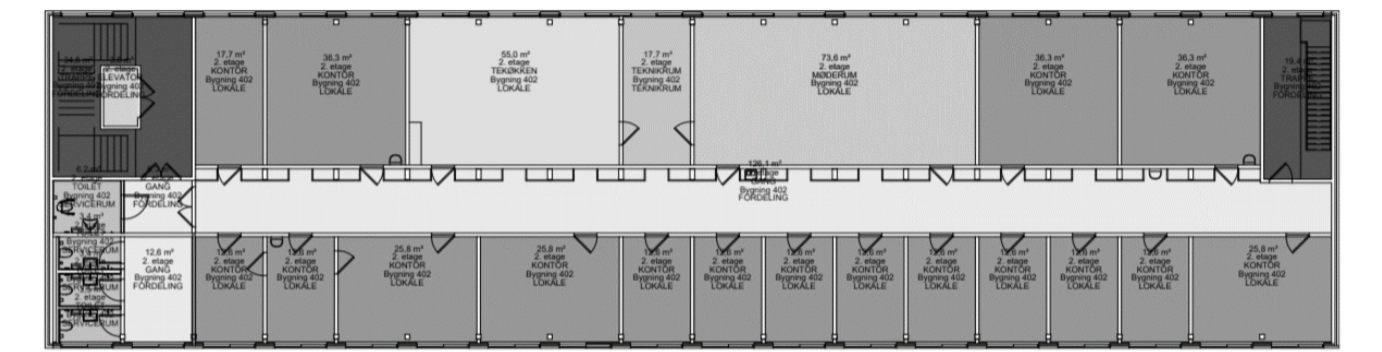
To assess the means used to obtain a good indoor environment an inspection of building 402 and 127 was carried out on the 28th of February from 1:30 pm to 2:30 pm. The active and passive means of the building was recognized with particular focus on the aspects of acoustic environment, thermal comfort, visual environment and air quality.



The means were identified by walking through the different rooms of the two buildings and documented with photos. While assessing the passive and active means, the perceived quality of the indoor environment was discussed, and the effects of the different means was evaluated.



Floor plan of building 127, 2. floor.



Floor plan of building 402, 2. floor.

### RESULTS

#### Building 402



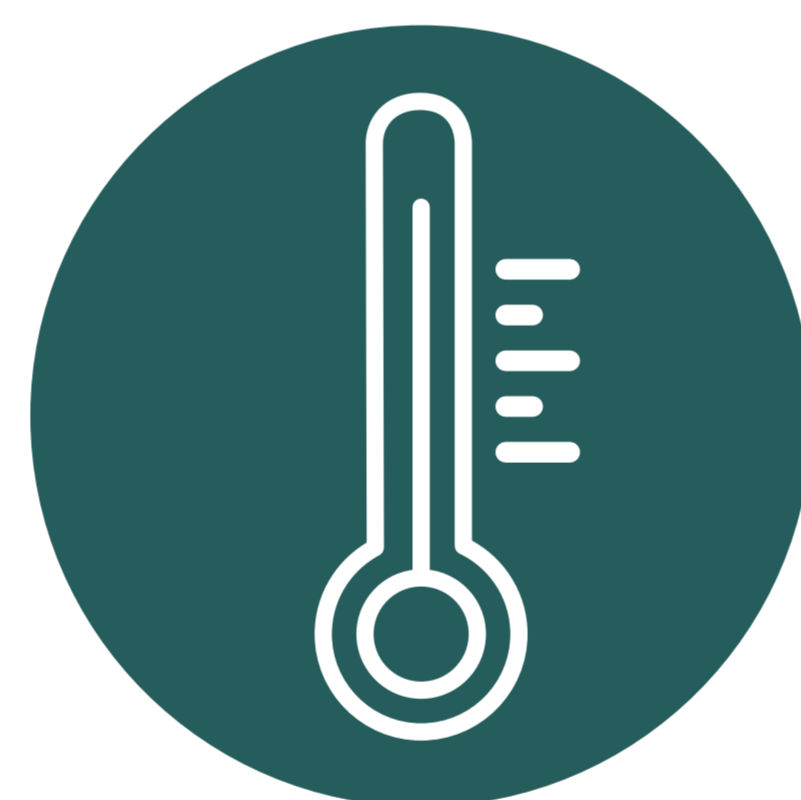
Building 402 uses different acoustic means in the ceilings, which help absorb sound and thereby enhancing the acoustical environment in the office and corridor. The 1<sup>st</sup> and 4<sup>th</sup> picture from the left are classic acoustic panels. The two middle pictures show lowered panels where the acoustic properties are present in the insulation layer hidden above the panel and thereby further improving the acoustic environment.



ACOUSTIC ENVIRONMENT



The thermal comfort is obtained mainly by active means. These active means are manually operated and include exterior shading, adjustable by a geared crank rod, operable windows and convector radiators regulated by mechanical thermostats. Because operable windows are the only means of cooling available in the offices, overheating in the summer period may seem like the biggest threat to the thermal comfort.



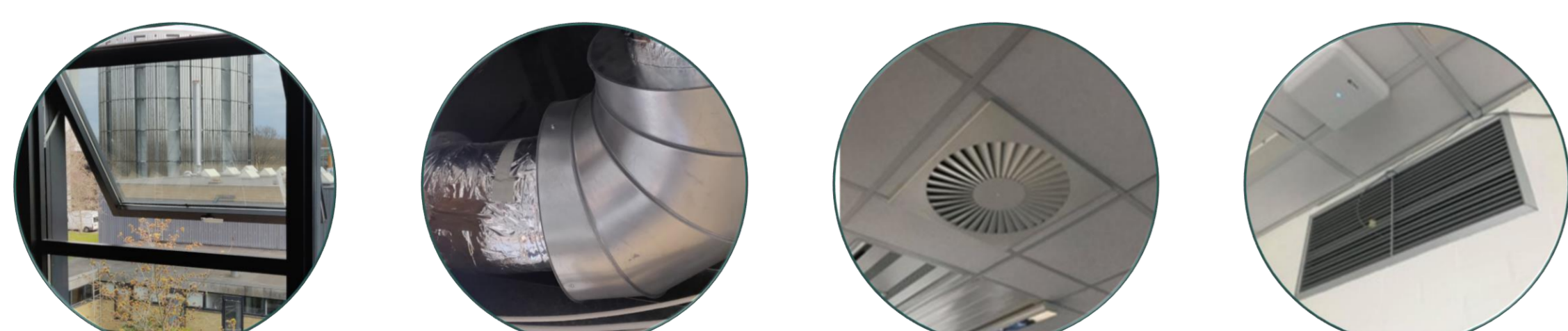
THERMAL COMFORT



Both offices and meeting rooms are designed with quite large windows providing a sufficient daylight level. The rooms are both equipped with interior and exterior solar shading. The interior solar shading is regular drapes controlled by the user. Likewise, the exterior solar shading is metal blinds, which are also manually controlled from by the occupant in each room. The artificial lighting is controlled by traditional switches without dimming.



VISUAL ENVIRONMENT

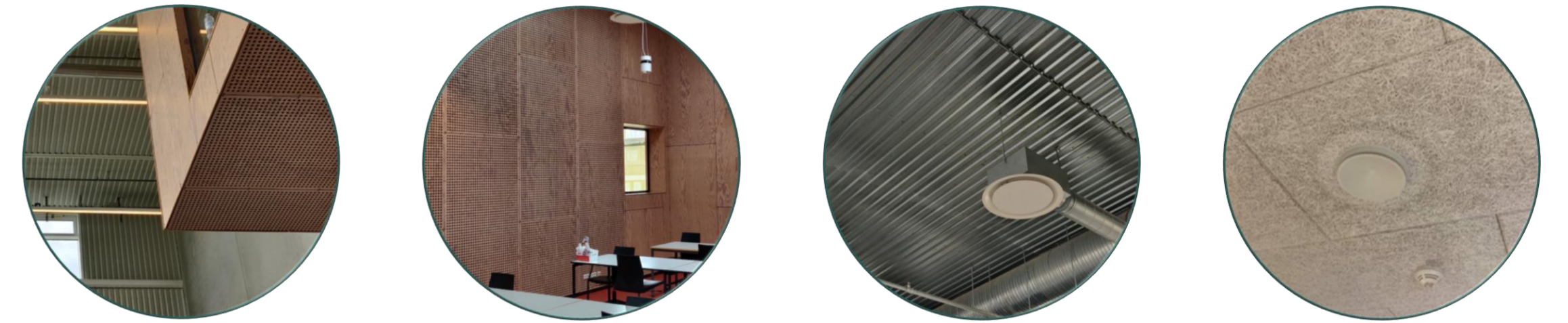


As documented on the pictures, Building 402 was originally designed with a complete mechanical ventilation system, supplying both offices and meeting rooms with recirculated air. The system has however been out of operation for several decades, which means that the only means to manage the quality of the indoor air is through passive ventilation, achieved by frequent opening of windows.



AIR QUALITY

#### Building 127



Building 127 handles the acoustic environment in a similar fashion to Building 402. Issues with acoustics can especially occur in large spaces with high ceilings, which is the case for the entrance hall in Building 127. Wooden acoustic panels have been installed on both the ceiling and the inner in the hallway and in all classrooms and group rooms. The ceilings in the classrooms and the entrance hall have perforated and bend metal panels which also have acoustic properties.



Passive means providing thermal comfort includes both a large thermal mass ensuring fewer temperature fluctuations and a floor to ceiling, triple-glazed, south facing curtain wall providing passive heating. The active means include cooling by mechanical ventilation, exterior shading panels and operable windows all controlled by thermal sensors as well as user-controlled panels providing zonal temperature setpoints and internal shading.



To achieve a good visual environment Building 127 has been designed with floor to ceiling curtain walls and skylights in the upper level allowing for maximum daylight penetration. All exterior glazing is equipped with exterior active solar shading, which is installed as moving components on the façade. The classrooms allow for user-controlled drapes for both the regular windows and skylights. The artificial lighting is both sensor- and user controlled and can be adjusted to the desired luminance.



To control the air quality in Building 127 the design uses both active and passive means. The levels are approximately double the ceiling height of regular ceiling height, which is done to increase the natural ventilation rate. Furthermore, inlets are installed in the hallway, classrooms, and group rooms across the building, which is connected to the mechanical ventilation system, ensuring frequent air changes.

### CONCLUSION

The examination of Building 127 and Building 402 on DTU showed several means to handle the overall indoor environment regarding all the factors used for the evaluation. The different strategies between the two different buildings showcase the technological advancements made in the area of indoor quality, which can be seen in Building 127. Building 402 uses mainly passive means, while Building 127 makes use of both active and passive means. It is quite fitting, since Building 127 is used for lectures regarding indoor environment, thus being a great example for future indoor climate engineers.